

## DESCRIPTION

## SPEAKER

## 5 TECHNICAL FIELD

The present invention relates to a speaker for use in various kinds of electronic equipment.

## BACKGROUND ART

10 Conventional speakers have the following general structures. One of the conventional speakers includes a frame, a magnetic circuit, a voice coil, a diaphragm, and a damper. The frame has a cylindrical shape with a bottom face and an open top. The magnetic circuit is placed on the inner bottom face of the frame. A coil portion of the  
15 voice coil is disposed in a magnetic gap of this magnetic circuit. The diaphragm is disposed in the opening of the frame so that the inner periphery thereof is fixed to the voice coil and the outer periphery thereof is fixed to the frame via an edge. The damper is fixed to the voice coil at one end thereof, and to the frame at the other end thereof.  
20 The speaker with this conventional structure is disclosed in Fig. 8 of Japanese Patent Unexamined Publication No. H11-150791, for example.

However, the conventional speaker has the edge along the outer periphery of the diaphragm, and the damper is fixed to the voice coil  
25 fixed to the diaphragm. In these edge and damper, the load imposed from the edge and damper in the upward and downward directions when the diaphragm moves vertically is not substantially constant. As a result, distortions can occur in reproduction of sounds.

Additionally, because both edge and damper are fixed to the frame, downsizing of the speaker is difficult in some cases.

## SUMMARY OF THE INVENTION

5       The present invention provides a speaker that prevents occurrence of distortions when the diaphragm vertically moves in sound reproduction and can be downsized.

A speaker of the present invention includes a frame, a magnetic circuit, a voice coil, a diaphragm, and a support. The frame has a  
10   cylindrical shape with a bottom face and an open top. The magnetic circuit is placed on the inner bottom face of the frame. A coil portion of the voice coil is disposed in a magnetic gap of this magnetic circuit. The diaphragm is disposed in an opening of the frame so that the inner periphery thereof is fixed to the voice coil and the outer  
15   periphery thereof is fixed to the frame via a first edge. The support is fixed to the diaphragm on the magnetic circuit side at one end of the support, and to the vicinity of the magnetic circuit via a second edge at the other end. The first edge is substantially analogous to the second edge in shape with respect to the boundary between the first and  
20   second edges.

With this structure that has no damper and has the diaphragm supported near the magnetic circuit via a support, the first edge along the outer periphery of the diaphragm is substantially analogous in shape to the second edge at the other end of the support, with respect  
25   to the boundary between the first and second edges. For this reason, the load imposed when the diaphragm vertically moves is substantially constant, and thus distortions in sound reproduction are unlikely to occur. Further, the second edge at the other end of the

support is fixed to the vicinity of the magnetic circuit. This structure allows downsizing more easily than fixing the second edge to the frame.

## 5 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view illustrating a structure of a speaker in accordance with a first exemplary embodiment of the present invention.

Fig. 2 shows characteristics of harmonic distortion factors of the speaker in accordance with the exemplary embodiment.

Fig. 3 is a sectional view illustrating a structure of a speaker in accordance with a second exemplary embodiment of the present invention.

Fig. 4 is a sectional view illustrating a structure of a speaker in accordance with a third exemplary embodiment of the present invention.

## REFERENCE MARKS IN THE DRAWINGS

	1	Frame
20	2	Magnetic circuit
	3	Magnetic gap
	4	Coil portion
	5	Voice coil
	6	First edge
25	7	Diaphragm
	8	Support
	9	Second edge
	10	Yoke

- 11 Magnet
- 12 Plate
- 13, 14 Fixed part

## 5 DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Hereinafter, a description is provided of exemplary embodiments of the present invention with reference to the accompanying drawings.

### 10 FIRST EXEMPLARY EMBODIMENT

Fig. 1 is a sectional view illustrating a structure of a speaker in accordance with the first exemplary embodiment of the present invention. Fig. 2 shows characteristics of harmonic distortion factors of the speaker of the exemplary embodiment. In Fig. 1, the speaker  
15 includes frame 1, magnetic circuit 2, voice coil 5, diaphragm 7, and support 8. Frame 1 has a cylindrical shape with a bottom face and an open top (shaped like a bowl). Magnetic circuit 2 is disposed on the inner bottom face of frame 1.

Voice coil 5 has a cylindrical shape so that coil portion 4 thereof  
20 is disposed in magnetic gap 3 of magnetic circuit 2. Diaphragm 7 is disposed in the opening of frame 1. The diaphragm has a donut shape so that the inner periphery thereof is fixed to voice coil 5, and the outer periphery thereof is fixed to frame 1 via first edge 6. Support 8 is fixed to diaphragm 7 on the side of magnetic circuit 2 at one end of  
25 the support, and to the upper end of yoke 10 of magnetic circuit 2 via second edge 9 at the other end. Magnetic circuit 2 is made of yoke 10, magnetic circuit 11, and plate 12.

Both of first edge 6 and second edge 9 are formed of a rubber

material. With reference to Fig. 1, first edge 6 has an upwardly-projecting circular section, and second edge 9 has a downwardly-projecting circular section. First edge 6 is substantially analogous to second edge 9 in shape with respect to the boundary therebetween. First edge 6 can be formed to have a downwardly-projecting circular section, and second edge 9 can be formed to have an upwardly-projecting circular section, in Fig. 1.

When sound electric signals are passed through coil portion 4 of voice coil 5 in the above structure, the influence of the magnetic flux in magnetic gap 3 allows voice coil 5 to vertically move diaphragm 7. Thus, sounds are reproduced. At this time, as described above, both of first edge 6 and second edge 9 are made of the same material, e. g. rubber materials. First edge 6 has an upwardly-projecting circular section, and second edge 9 has a downwardly-projecting circular section.

With this structure, first edge 6 is substantially analogous to second edge 9 in shape with respect to the boundary therebetween, and first edge 6 and second edge 9 are made of the same material. For this reason, the load imposed when diaphragm 7 vertically moves is the same even in the upward motion and downward motion of diaphragm 7. As a result, distortions are unlikely to be caused by asymmetrical upward and downward motions in sound reproduction.

As shown by "conventional speaker" in Fig. 2, the load imposed by the edge and damper of the conventional speaker when the diaphragm vertically moves is not substantially constant in the upward and downward directions. As a result, particularly at low frequencies, large distortions occur. In contrast, for a speaker of this exemplary embodiment, as similarly shown by "speaker of the present

invention", the load imposed when diaphragm 7 vertically moves is the same in the upward and downward motions of diaphragm 7. Thus, it is understood that even at low frequencies, occurrence of harmonic distortions are considerably reduced in comparison with the conventional speaker.

If second edge 9 at the other end of support 8 is fixed to frame 1 on the outer peripheral side of magnetic circuit 2 like the conventional structure, the frame must be enlarged so that the second edge is movable. However, because second edge 9 at the other end of support 8 is fixed to the end of yoke 10 in this exemplary embodiment, a movable range of second edge 9 is sufficiently ensured on the outer peripheral side of yoke 10 even without frame 1 enlarged. As a result, the speaker can easily be downsized.

## 15 SECOND EXEMPLARY EMBODIMENT

Fig. 3 is a sectional view illustrating a structure of a speaker in accordance with the second exemplary embodiment of the present invention. In Fig. 3, same elements used in Fig. 1 are denoted with the same reference marks and descriptions thereof are omitted. The speaker of this exemplary embodiment includes cylindrical fixed part 13 along the outer periphery of yoke 10. Second edge 9 is fixed to the upper end of fixed part 13. This structure can prevent the inflow of an adhesive into magnetic gap 3 when second edge 9 is bonded with the adhesive, and ensure the distance from the second edge to magnetic gap 3 and a bonding space at the same time.

As described above, similar to the first exemplary embodiment, first edge 6 is substantially analogous to second edge 9 in shape with respect to the boundary therebetween. Thus, the load imposed when

diaphragm 7 vertically moves is the same in the upward and downward motions of diaphragm 7. As a result, distortions are unlikely to occur in sound reproduction. As for the harmonic distortion factors of this embodiment, substantially similar characteristics to those of the first exemplary embodiment shown in Fig. 2 can be obtained. Further, because second edge 9 at the other end of support 8 is fixed to fixed part 13 provided along the outer periphery of yoke 10, a movable range of second edge 9 is sufficiently ensured on the outer peripheral side of fixed part 13 even without the frame enlarged. As a result, the speaker can easily be downsized.

In similar to a third exemplary embodiment, which will be described later, when the distance from the bottom face of frame 1 to the side end face of second edge 9 of fixed part 13 is smaller than the distance from the bottom face to the end of yoke 10 constituting magnetic circuit 2, the inflow of the adhesive into magnetic gap 3 can more securely be prevented.

### THIRD EXEMPLARY EMBODIMENT

Fig. 4 is a sectional view illustrating a structure of a speaker in accordance with the third exemplary embodiment of the present invention. In Fig. 4, same elements used in Fig. 1 are denoted with the same reference marks and descriptions thereof are omitted. The speaker of this exemplary embodiment includes cylindrical fixed part 14 integral with frame 1 along the outer periphery of yoke 10, and second edge 9 is fixed to the upper end of fixed part 14. The distance from the bottom face of frame 1 to the side end face of second edge 9 of fixed part 14 is smaller than the distance from the bottom face to the end of yoke 10 constituting magnetic circuit 2. In other words, the

height of fixed part 14 is smaller than the end of yoke 10 in the direction toward the bottom face of frame 1.

With this structure, the height of fixed part 14 to which second edge 9 is bonded is smaller than the height of yoke 10. This can more  
5 securely prevent the inflow of an adhesive into magnetic gap 3 when second edge 9 is bonded with the adhesive, and ensure the distance from the second edge to magnetic gap 3 and an adhesive space. Further, this embodiment has an advantage of reducing the number of components and costs, in comparison with the second exemplary  
10 embodiment. The height of fixed part 13 of the second exemplary embodiment can be reduced in similar to the fixed part of the third exemplary embodiment.

As described above, similar to the first and second exemplary embodiments, first edge 6 is substantially analogous to second edge 9  
15 in shape with respect to the boundary therebetween. Thus, the load imposed when diaphragm 7 vertically moves is the same in the upward and downward motions of diaphragm 7. As a result, distortions are unlikely to occur in sound reproduction. As for the harmonic distortion factors of this embodiment, substantially similar  
20 characteristics to those of the first exemplary embodiment shown in Fig. 2 can be obtained. Further, because second edge 9 at the other end of support 8 is fixed to fixed part 13 provided along the outer periphery of yoke 10, a movable range of second edge 9 is sufficiently ensured on the outer peripheral side of fixed part 13 even without the  
25 frame enlarged. As a result, the speaker can easily be downsized.

## INDUSTRIAL APPLICABILITY

As described above, a speaker of the present invention is



unlikely to cause distortions when a diaphragm thereof vertically moves in sound reproduction and can be downsized. Thus, the invention is useful as a speaker, for example, for use in various kinds of electronic equipment.